Roll No. .....

Total No. of Questions : **9**] [Total No. of Printed Pages : **4**

(2036)

UG (CBCS) Annual IInd Year Examination

1502

B.Sc. PHYSICS

(Statistical and Thermal Physics)

(DSC-1C)/Core

Paper : PHYS 201 TH

Time : 3 Hours] **[Maximum Marks : 50**

Note :– Attempt *five* questions in all, selecting *one* question each from Sections–B, C, D and E. Question No. **1** is compulsory. Use of simple calculator is allowed.

Section–A

(Compulsory Question)

1. Attempt all the seven sub-questions :

   (a) Define microstate, macrostate and thermodynamic probability.

   (b) 'Entropy is the measure of disorder'. Explain.

Section–E

8. (a) What is Joule-Thomson effect ? Discuss its complete thermodynamic treatment.

   (b) Prove that there is no change in temperature of an ideal gas due to Joule-Thomson effect. [6,3]

9. (a) Derive Maxwell's thermodynamic relations.

   (b) Derive the expression for Clausius-Clapeyron equation. [5,4]

(c) State Stefan's law for blackbody radiations.

(d) Calculate the temperature of inversion for a gas where Van der Waals Constants are $a = 0.025\ m^4N\ mol^{-1}$, $b = 2.67 \times 10^{-5} m^3\ mol^{-1}$ $R = 8.4\ J\ mol^{-1}K^{-1}$.

(e) Discuss blackbody radiation spectrum.

(f) Define extensive and intensive parameters. Give examples.

(g) Differentiate between fermions and bosons.

[7×2=14]

Section–B

2. (a) Differentiate between static and dynamic systems.

(b) Prove that for a dynamic system the fraction of the total time that the system spends in any macrostate, is proportional to the thermodynamic probability of that macrostate. [3,6]

3. (a) Discuss the distribution of n distinguishable particles in 'k' compartments which are further sub-divided into 'g' cells of equal a priori probability.

(b) Write down the various microstates and macrostates for a system of 2 distinct particles distributed in 2 equal sized compartments. [5,4]

Section–C

4. (a) Determine the phase space cells in the momentum interval p to $p + dp$.

(b) Using Maxwell–Boltzmann Statistics :

$$n(E)dE = \frac{2\pi n}{(\pi kT)^{3/2}} E^{1/2} e^{-E/kT} dE$$

Derive expression for 'Average speed', (RMS Speed) and 'Most Probable Speed'. [3,6]

5. (a) What are fermions ? State the postulates of Fermi-Dirac Statistics. Hence derive Fermi-Dirac Statistics.

(b) Differentiate between MB, BE and FD Statistics. [6,3]

Section–D

6. What is a thermocouple ? Define thermoelectric effect, Thomson effect and Peltier effect. Hence obtain expression for thermoelectric emf, Peltier coeffcient and Thomson coefficient. [9]

7. (a) What is entropy ? Give its statistical definition. Hence prove that entropy is additive in nature.

(b) Discuss two examples of Law of increase of entropy.

(c) 'Thermocouple acts as a heat engine.' Comment. [4,3,2]